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ABSTRACT

This module uses concepts of fingerprinting to illustrate and apply selected mathematical ideas. Specifically, students participate in activities that require pattern recognition, measuring using mm and cm, and identification of similar patterns. Inking of students' prints is done. Teaching suggestions are provided. (MK)

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ENVIRONMENTAL MODULE FOR USE

IN A

MATHEMATICS LABORATORY SETTING

People Patterns - FINGERPRINTING

by

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SE 030 306

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TEACHER'S GUIDE

People Patterns - FINGERPRINTING

This module may be used in many ways.

1. It may be used as a complete unit.
2. It may be used in part or in total to supplement other materials you already have.
3. You will probably want to follow the natural order in this module. Students will need some background for these activities. Each worksheet provides background for the next worksheet.

Materials

.Contained in this module:

1. Blow-ups of fingerprints
2. FBI characteristic naming list.

.Teacher must provide:

1. Centimeter rulers
2. Ink pad
3. White paper.

.Optional (Teacher provides):

1. Hand lens.

OBJECTIVES

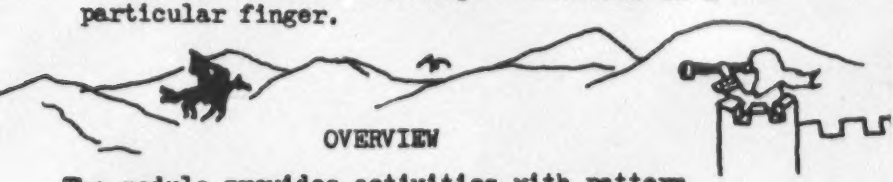
.Given a fingerprint, the student will be able to identify at least one characteristic.

.Given two sets of prints, (from the same person, same finger, same hand) the student will be able to identify and po'nt out at least four characteristics.

.Given prints from a group of people, the student will be able to break people into smaller groups using fingerprint characteristics as a basis for grouping.

.Given a set of fingerprints, the student will be able to measure and count the number of ridges per centimeter.

.Given a set of prints from a group of people, the student will be able to figure percentages of total group with whorls, loops and arches on a particular finger.



OVERVIEW

.The module provides activities with pattern recognition.

.Student Worksheet #'s 1 and 8 provide measuring experience for students using mm. and cm.

.Student Worksheet #'s 4 and 7 require identifying similar patterns.

.Student Worksheet #'s 1, 3, 5 and 8 require inkings of students' prints.

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I. Student Worksheet #'s 1, 2, 2A and 3

A. Materials provided:

1. Student Worksheet #'s 1 to 3
2. FBI characteristic naming sheet

B. Materials needed:

1. Ink pad
2. White paper
3. Centimeter rulers
4. Hand lens (optional)

C. Work to be completed by the students:

1. Student Worksheet #'s 1 to 3

D. Teaching suggestions:

1. You may want to introduce the activities with some work on similarities of geometric shapes.

2. You may wish to use newspaper clippings of crimes solved by fingerprints to create interest.

3. You should try to make students aware of the fact that these activities are not designed to make a person a fingerprint expert. They are designed to show some types of patterns people possess.

II. Student Worksheet #'s 4 to 8

A. Materials provided:

1. Student Worksheet #'s 4 to 8

2. Fingerprint blow-ups (4A, 4B, 4C, 6A, 6B, 7A, 7B and 7C)
3. Student information sheet #9 (Optional)

B. Materials needed:

1. Ink pad
2. Centimeter rulers
3. Hand lens (optional)

C. Work to be completed by the students:

1. Student Worksheet #'s 4 to 8

D. Teaching suggestions:

1. You may wish to group students for some of the activities.

2. You might point out to the students that any person interested in fingerprint analysis, as a career, should seek information directly from the local police department, the State Bureau of Investigation, or write the FBI in Washington, D.C.

3. Information sheet #9 is a copy of the actual FBI handout on prints. You may want to show some of the more interested students this sheet. They could use this sheet for more exact pattern classifications.

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ANSWER KEY

Student Worksheet #4:

Most prominent characteristic on 4A is a loop, on 4B it is a whorl and on 4C it is an arch.

Student Worksheet #6:

1. Either b, f or h (bifurcation)
2. c (short ridge)
3. Either a, e, g, i, j, k, l (ending ridge)
4. Either a, e, g, i, j, k, l (ending ridge)
5. Either b, f or h (bifurcation)
6. Either a, e, g, i, j, k, l (ending ridge)
7. Either b, f or h (bifurcation)
8. d (indentation in recurving ridge)

9-12. Either a, e, g, i, j, k, l (all are ending ridges).

Student Worksheet #7:

7A matches with 4A, 7B matches with 4C and 7C matches with 4B.

Sticky Fingers

You will need an ink pad for this activity. (An ink pad may be made by blacking an area of paper with a pencil.)

Lightly rub a finger on the ink pad. Next, roll the finger on a white piece of paper. Take prints from each finger. You may want to use a hand lens to observe the patterns from each print.

Sketch as many distinct patterns as possible from your set of prints. Make up a name for each pattern.

Using a centimeter rule, find how many ridges (lines) there are per centimeter on each finger. Is the number of ridges per centimeter the same for each finger?

Find the average number of ridges per centimeter for all fingers. Compare this average (mean) with a neighbor. Are they the same?

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What's In a Name?

Do any of your fellow students have the same type of patterns in their prints? If so, are your names for the patterns the same? What problems might you have in tracing prints if everybody had different names for the same type of prints?

Compare the type of patterns on the fingers of your left hand with the type of patterns on your right hand. Are there any similarities between the "same" fingers on each hand? (Same, meaning index finger of left hand matched with index finger of right hand, etc.)

On Student Worksheet #2A, you will find the classifying sheet used by the FBI, police departments and other agencies. This sheet gives the name and description these departments and agencies use. Reclassify your patterns, using the standard names. Does the reclassification aid you when you compare with fellow students who have also reclassified?

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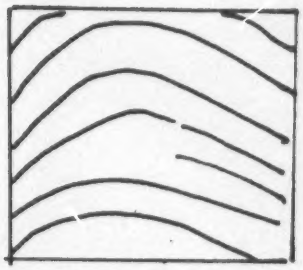
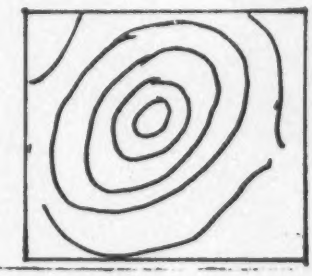
An arch is that type of pattern in which the ridges enter upon one side, make a rise or curve in the center, and flow out upon the opposite side. Some arches possess an angle or an up-thrust.

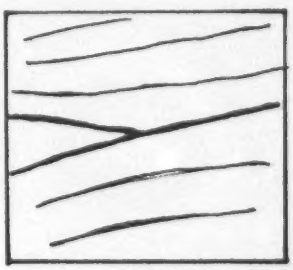


A loop is that type of pattern in which one or more ridges enter upon either side, recurve or touch and pass out upon the side from which the ridge entered.

A whorl consists of one or more ridges which make a complete circuit. (A circular pattern formed by one or more ridges.)



A bifurcation is a point where two ridges meet.



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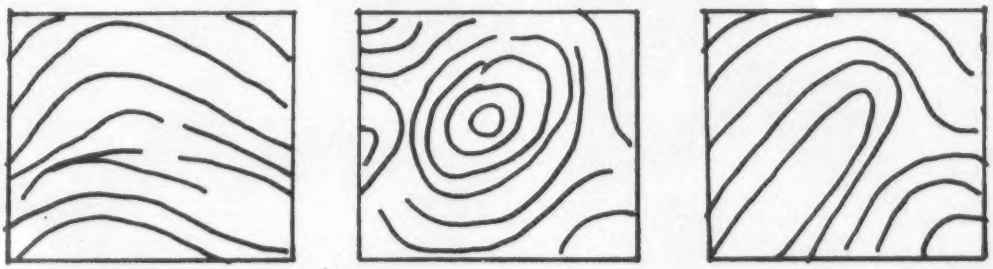
Place a classmate's thumb on the ink pad. Press the thumb on a piece of paper. Then lightly roll the thumb from side-to-side <u>once</u> to make a good impression of the thumbprint.

The following illustrations are examples of some fingerprint types which are considered basic to all fingerprinting.



ARCH WHORL LOOP

Take thumbprints of all members of your class. Write the name of each person below his thumbprint.

How many people in your class have at least one whorl? How many people in your class have at least one loop? How many people in your class have at least one arch?

Rank the patterns in order of frequency exhibited in your class. Can you determine the percentage of people with each pattern?

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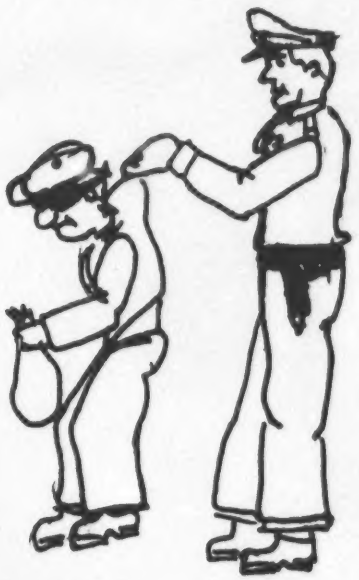
Blow-Up -- Gotcha

The blow-up prints shown on Student Worksheet #'s 4A, 4B, and 4C were blow-ups made by the Arapahoe County Sheriff's Department in Colorado. The blow-ups are similar to blow-ups used in courts as evidence.

Name the most prominent characteristic of each print. Can you find a minor characteristic on each? (A characteristic is a particular pattern of a particular finger; a whorl on the left thumb is a characteristic.)



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Group people in your class. Use the same characteristics on the same finger as the basis for your groups. For example: John and Pete both have whorls on their left index finger.

Are there any personal traits or characteristics associated with your groups? (The people in group A are all males, the people in group B are all females, the people in group C are all thin, etc.)

Outside activity

How many people in your family have the same major characteristic on the same fingers? (Dad and I both have loops on our right pinky fingers.) Compare the results from all members in your room. Can you make some generalization about family patterns? (Is there a family pattern?)

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Fingerprints are one way to identify people. The courts use fingerprints as conclusive evidence to prove identity. The courts determine how many identifying characteristics from a known print to an unknown print are needed to assure identification. Generally, the courts require 12 characteristics.

Student Worksheet #'s 6A and 6B each have 12 characteristics pointed out. Student Worksheet #6A is a blow-up of a latent print. A latent print is an unknown print found at the scene. An inked print taken from a suspect is shown on Student Worksheet #6B. These blow-ups were actually used in court to determine guilt of a criminal.

The probability of two people having the same characteristics in the same relative position is astronomical.

Below is the list of identifying characteristics. Match each number with a letter from the identifying characteristics.

a) ending ridge
b) bifurcation
c) short ridge
d) indentation in recurving ridge
e) ending ridge
f) bifurcation
g) ending ridge
h) bifurcation
i) ending ridge
j) ending ridge
k) ending ridge
l) ending ridge

Your teacher has the answer sheet. Use the following scale to determine your score.

12 right	Hawaii Five-O needs you
11 right	Dead-eye! Dragnet wants you
10 right	FBI can use you
9 right	Try Gunsmoke
Less than 9 right	Mission Impossible; try again.

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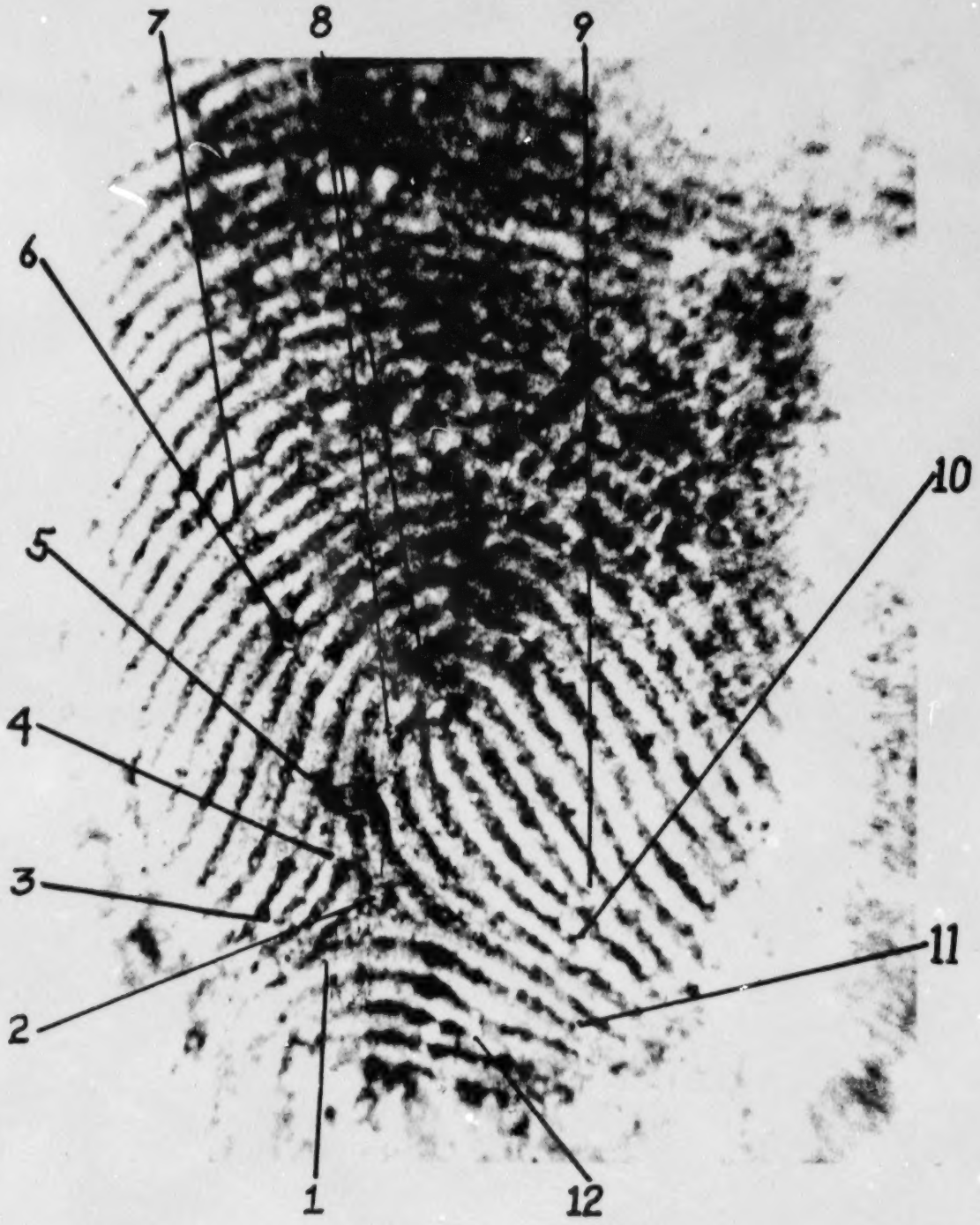
LATENT



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INKED

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Detective Dan

Student Worksheet #'s 7A, 7B, and 7C are smaller blow-ups of Student Worksheet #'s 4A, 4B, and 4C. Match each smaller blow-up with the corresponding larger blow-up.

See if you can find five or more matching characteristics for each pair.

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Hand, Hand, Finger - - Toe?

Fingerprints are not the only way to identify people. Gloves may cover your prints, but each glove has a distinct pattern. These patterns are also acceptable in court. Nose prints (looking through windows), ear prints, toe prints, and lip prints (cigarettes) are other examples. Toe prints have been used to identify a burglar who worked barefoot to avoid shoe prints.

Do toe prints have any characteristics that are the same as finger prints? Do <u>your</u> toe prints have any characteristics in common with your finger prints?

Make a set of toe prints, measure the distances between ridges. How do they compare with ridge distances of thumb prints? Is there a ratio governing this distance? (Hint: a way to develop distances is to find the number of ridges per centimeter.) Is your $\frac{\text{toe}}{\text{thumb}}$ ratio the same as your neighbor's?

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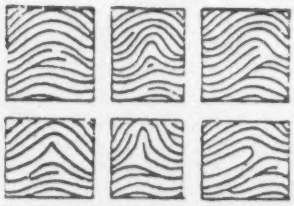
Arch

A PLAIN ARCH IS THAT TYPE OF PATTERN IN WHICH THE RIDGES ENTER UPON ONE SIDE, MAKE A RISE OR CURVE IN THE CENTER, AND FLOW OR TEND TO FLOW OUT UPON THE OPPOSITE SIDE, WITHOUT FORMING AN ANGLE OR UPTHRUST, AND LACKING TWO OF THE BASIC CHARACTERISTICS OF THE LOOP

A TENTED ARCH IS THAT TYPE OF PATTERN WHICH POSSESSES EITHER AN ANGLE, AN UPTHRUST, OR TWO OF THE THREE BASIC CHARACTERISTICS OF THE LOOP



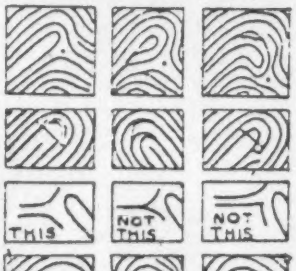
Loops

A LOOP IS THAT TYPE OF PATTERN IN WHICH ONE OR MORE RIDGES ENTER UPON EITHER SIDE, RECURVE, TOUCH OR PASS AN IMAGINARY LINE BETWEEN DELTA AND CORE AND PASS OUT OR TEND TO PASS OUT UPON THE SIDE FROM WHICH SUCH RIDGE OR RIDGES ENTERED

A SUFFICIENT RECURVE CONSISTS OF THE SPACE BETWEEN THE SHOULDERS OF A LOOP, FREE OF ANY APPENDAGES WHICH ABUT UPON IT AT A RIGHT ANGLE.

TYPE LINES ARE THE TWO INNERMOST RIDGES WHICH START OR GO PARALLEL, DIVERGE, AND SURROUND OR TEND TO SURROUND THE PATTERN AREA

THE DELTA IS THAT POINT ON A RIDGE AT OR NEAREST TO THE POINT OF DIVERGENCE OF TWO TYPELINES, AND LOCATED AT OR DIRECTLY IN FRONT OF THE POINT OF DIVERGENCE.



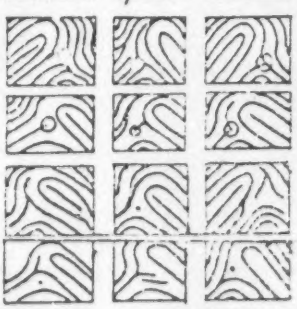
DELTA RULES

1 WHEN THERE ARE TWO OR MORE POSSIBLE DELTAS WHICH CONFORM TO THE DEFINITION, THE ONE NEAREST THE CORE SHOULD BE CHOSEN

2 THE DELTA MAY NOT BE LOCATED IN THE MIDDLE OF A RIDGE RUNNING BETWEEN THE TYPE-LINES TOWARD THE CORE, BUT AT THE NEARER END ONLY

3 THE DELTA MAY NOT BE LOCATED AT A BIFURCATION WHICH DOES NOT OPEN TOWARD THE CORE.

4 WHERE THERE IS A CHOICE BETWEEN A BIFURCATION AND ANOTHER TYPE OF DELTA, THE BIFURCATION IS SELECTED



Whorl

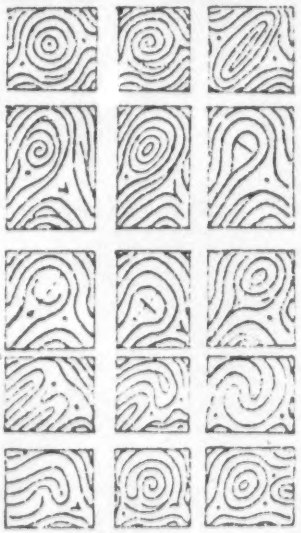
A PLAIN WHORL CONSISTS OF ONE OR MORE RIDGES WHICH MAKE A COMPLETE CIRCUIT, WITH TWO DELTAS, BETWEEN WHICH, WHEN AN IMAGINARY LINE IS DRAWN, AT LEAST ONE RECURVING RIDGE IS CUT OR TOUCHED

A CENTRAL POCKET LOOP CONSISTS OF AT LEAST ONE RECURVING RIDGE, OR AN OBSTRUCTION AT RIGHT ANGLES TO THE LINE OF FLOW, WITH TWO DELTAS, BETWEEN WHICH, WHEN AN IMAGINARY LINE IS DRAWN, NO RECURVING RIDGE WITHIN THE PATTERN AREA IS CUT OR TOUCHED

THE LINE OF FLOW OF A CENTRAL POCKET LOOP IS DETERMINED BY DRAWING AN IMAGINARY LINE BETWEEN THE INNER DELTA AND THE CENTER OF THE INNERMOST RECURVING RIDGE

A DOUBLE LOOP CONSISTS OF TWO SEPARATE LOOP FORMATIONS, WITH TWO SEPARATE AND DISTINCT SETS OF SHOULDERS AND TWO DELTAS

AN ACCIDENTAL CONSISTS OF A COMBINATION OF TWO DIFFERENT TYPES OF PATTERN, WITH THE EXCEPTION OF THE PLAIN ARCH, WITH TWO OR MORE DELTAS, OR A PATTERN WHICH POSSESSES SOME OF THE REQUIREMENTS FOR TWO OR MORE DIFFERENT TYPES, OR A PATTERN WHICH CONFORMS TO NONE OF THE DEFINITIONS



NOTE: A bifurcation is where two ridges meet.

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